Session 107

2D Graphics Using Quartz

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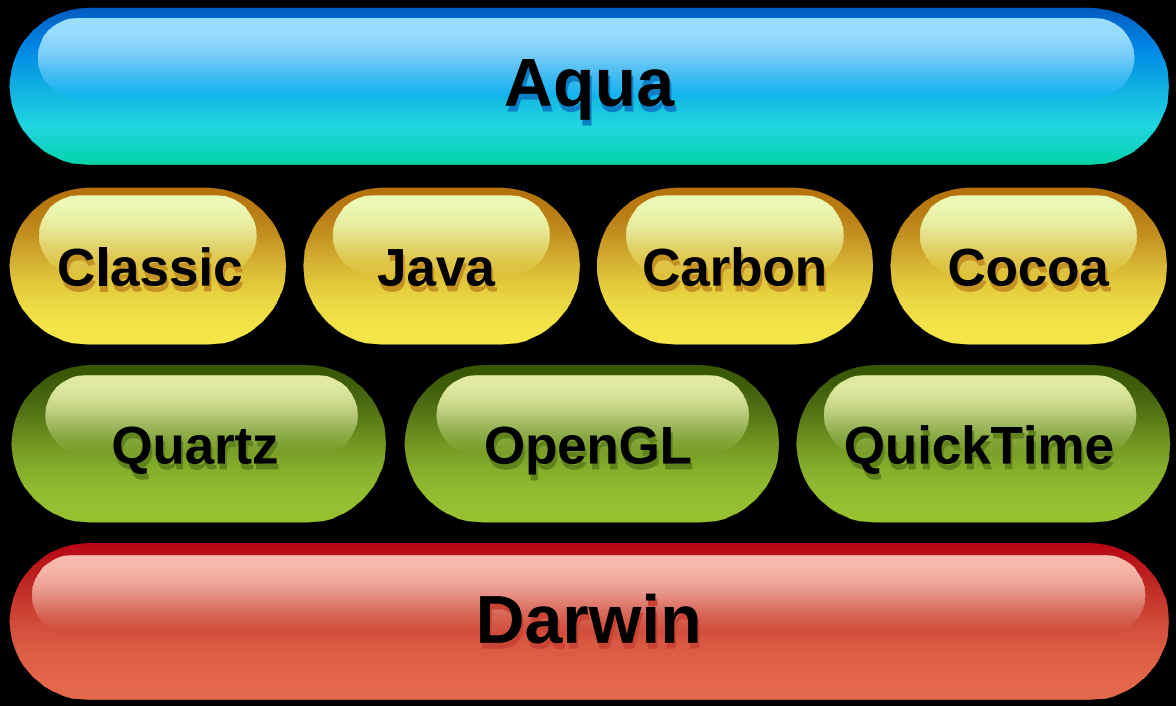
Agenda

- What Is Quartz?
- Quartz Architecture
- Quartz API
- Demo

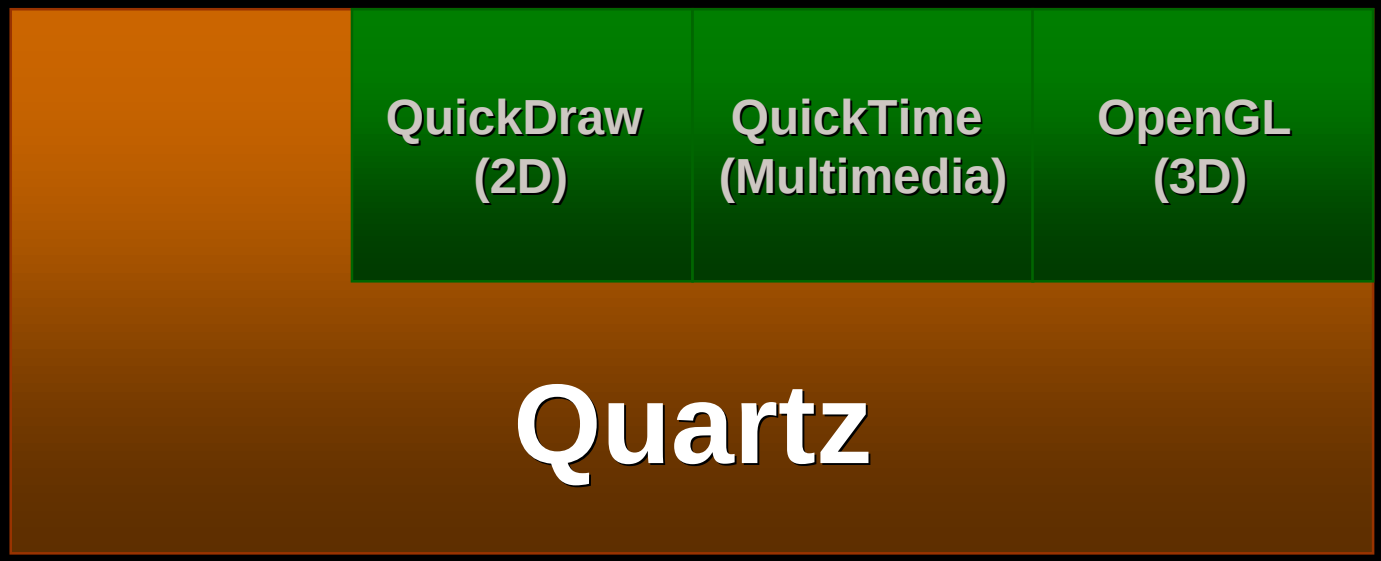
What Is Quartz?

- Quartz is the graphics system on Mac OS X

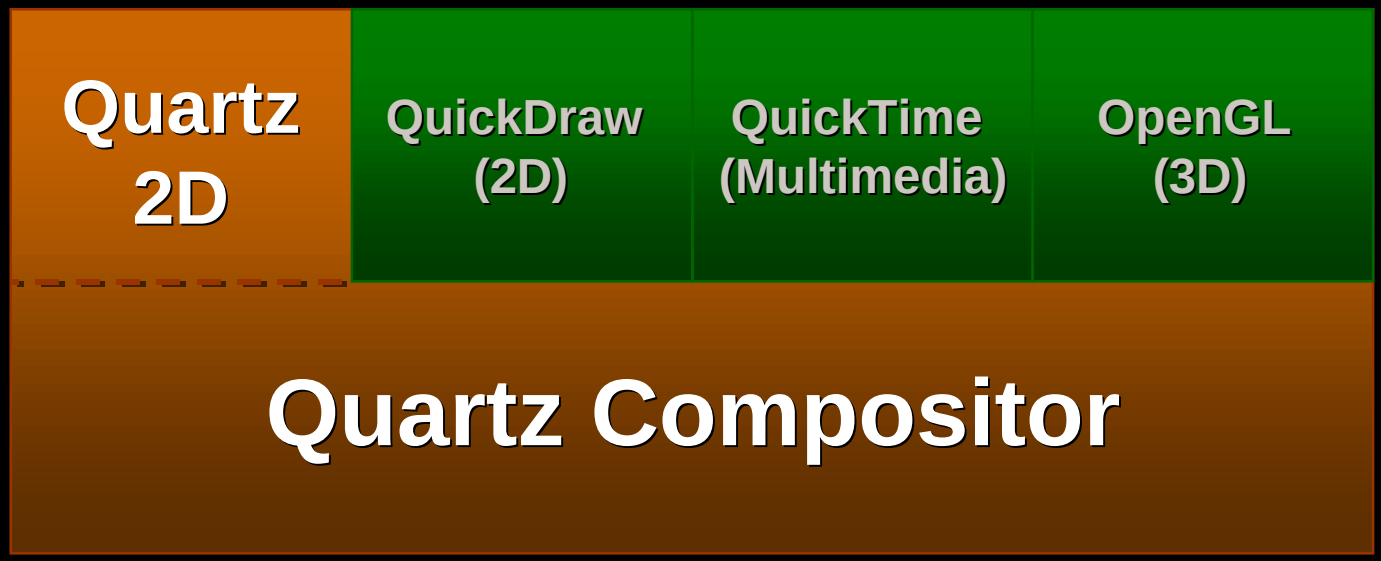
System Architecture



Application Services



Quartz


Quartz 2D
QuickDraw (2D)
QuickTime (Multimedia)
OpenGL (3D)
Quartz Compositor

Quartz 2D

- Lightweight low-level 2D rendering library
- Based on PDF imaging model
- Resolution and device independent
- ColorSync incorporated
- ATS incorporated

Where Is Quartz Used?

- Higher level application services use it
  - Cocoa
  - Carbon
  - Java
- Accessible to your application through the CoreGraphics.framework

When to Use Quartz?

- For 2D graphics in Carbon instead of QuickDraw
- For full screen access
- For remote access API
- Window management handled by Carbon, Cocoa, Java APIs

Quartz 2D API

- C based interface
- CoreFoundation style naming convention
- CG “class” “verb” “object”
  - e.g., **CGContextDrawImage**

CoreGraphics Classes

- Context
- Geometry
- Font/Text
- Image
- PDF Document
- Affine Transforms
- Color Spaces
- Data Managers

CG Context

- Connection to the device
- Device independent abstraction
- Maintains state information
  - e.g., fill, stroke styles, color space, font info, transformation matrix
  - Save and restore state (stackable)

CG Context

- Contexts supported:
  - Window—from Cocoa or Carbon
  - PS—from printing
  - PDF—**CGPDFContextCreate**
  - Bitmap—**CGBitmapContextCreate**

Drawing Primitives

- Primitives:
  - Vector Geometry
  - Text
  - Images
  - PDF Document
- Rendered using painter's algorithm
- Floating point coordinates

Vector Geometry

- Path Definition
  - CGContextBeginPath
  - CGContextMoveToPoint
  - CGContextAddLineToPoint
  - CGContextAddCurveToPoint
  - CGContextAddQuadCurveToPoint
  - CGContextClosePath
- Path Drawing
  - CGContextDrawPath

Path Example

CGContextBeginPath

CGContextMoveToPoint

CGContextLineToPoint

CGContextCurveToPoint

CGContextLineToPoint

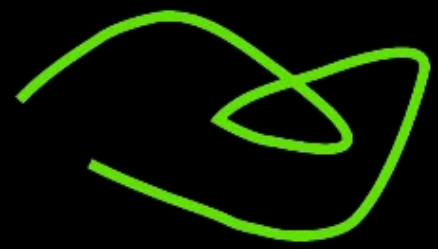
CGContextCurveToPoint

CGContextClosePath

Vector Geometry

- Convenience functions:
  - Rects, Lines, Arcs
- Drawing Operations:
  - Fill, EOFill, Clip, EOClip, Stroke
- Stroking parameters:
  - Width, line joins, line caps, miterlimit, line dash

Path Examples



Text

- Draw glyphs from outline fonts
- TrueType, Type1 and CID font support available through ATS
- Fill, Stroke, Clip text
- Use ATSUI for Unicode or layout support

Using Text in Quartz 2D

- Set a **CGFontRef** into Context
- Set Text Drawing Mode
  - Fill, Stroke, Clip
- Draw Text using:
  - **CGContextShowText**
  - **CGContextShowGlyph**
  - **CGContextShowTextAtPoint**
  - **CGContextShowGlyphAtPoint**

Images

- Support for various color spaces
  - RGB, LAB, CMYK, ICC Profiles
- Support for alpha channel
  - Premultiplied or not
- Support for 1- and 8-bit Image Mask

Using Images in Quartz 2D

- Create a **CGImageRef** using **CGImageCreate**
  - Specify width, height, bitsPerComponent, bitsPerPixel, ColorSpace, AlphaInfo, DataProvider
- Draw using **CGContextDrawImage**

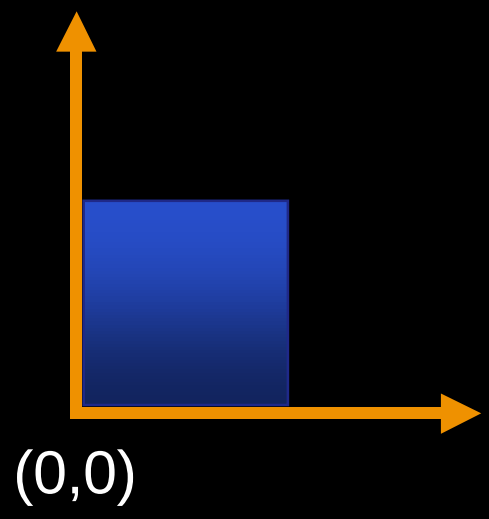
PDF Documents

- Create a **PDFDocumentRef**
- Draw a **PDFDocumentRef** to a context
  - **CGContextDrawPDFDocument**
- Get bounding box information about the PDF Document

Transformation Model

- Initial coordinate system
- Transformation modifies the coordinate system
- Examples: Rotations, Translate, Scale, Skews
- Affine Transformations

Transformations

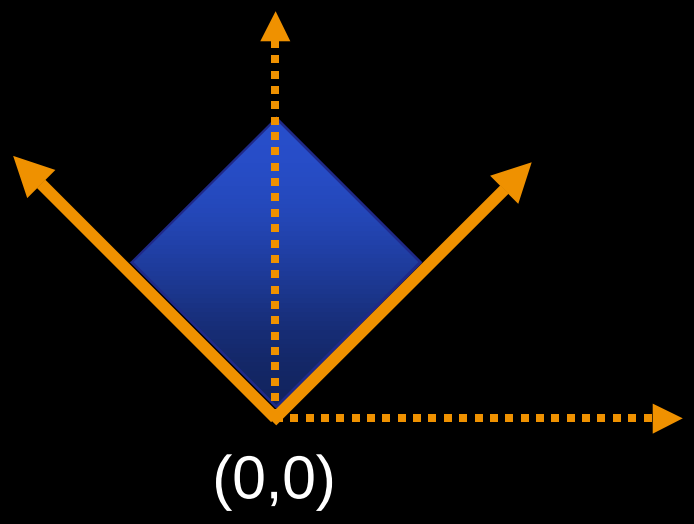


CGContextBeginPath

CGContextAddRect

CGContextDrawPath

Transformations



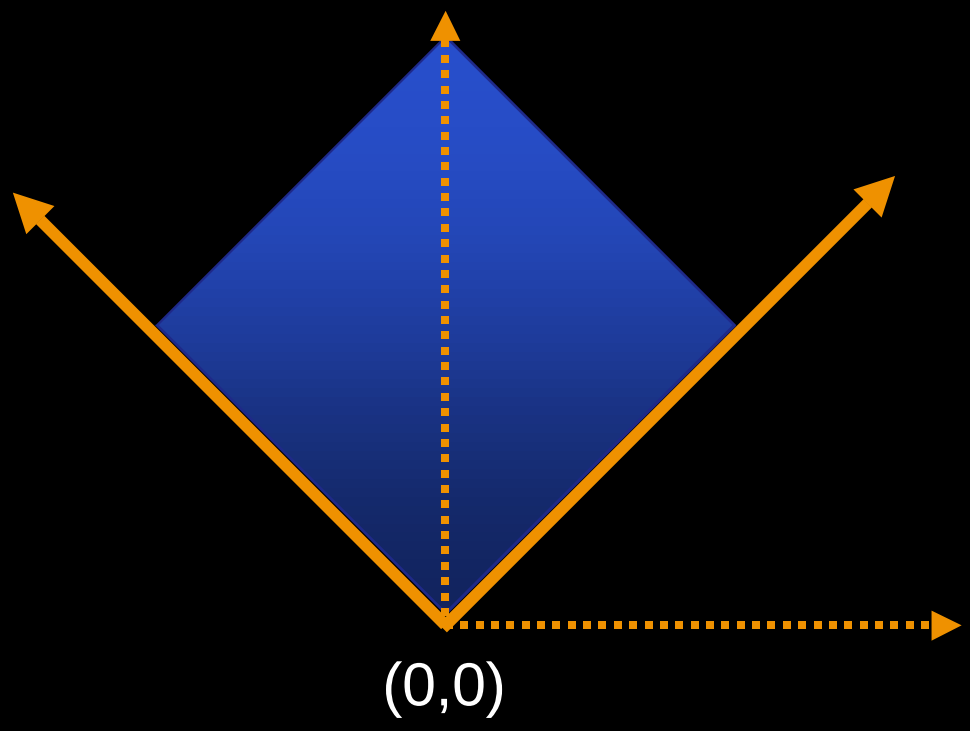
CGContextRotateCTM

CGContextBeginPath

CGContextAddRect

CGContextDrawPath

Transformations



CGContextRotateCTM

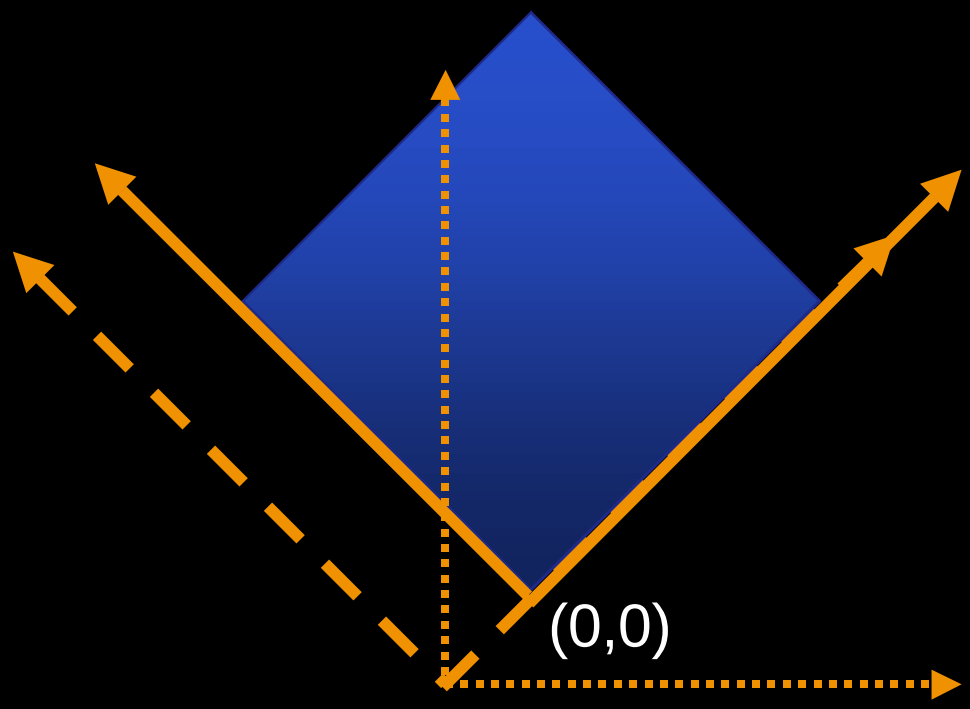
CGContextScaleCTM

CGContextBeginPath

CGContextAddRect

CGContextDrawPath

Transformations



CGContextRotateCTM

CGContextScaleCTM

CGContextTranslateCTM

CGContextBeginPath

CGContextAddRect

CGContextDrawPath

Color Spaces

- Supported spaces:
  - Device: RGB, Gray, CMYK
  - Calibrated: RGB, Gray
  - LAB
  - ICC Profile based
  - Indexed

Setting Color

- Create a **CGColorSpaceRef**
- Set the fill/stroke color space
  - **CGContextSetFillColorSpace**
  - **CGContextSetStrokeColorSpace**
- Set the color values
  - **CGContextSetFillColor**
    - Pass in an array of color values

Transparency

- Set global alpha
  - **CGContextSetAlpha**
- Set Fill/Stroke color and alpha
  - **CGContextSetRGBFillColor**
- Supported on screen and bitmap contexts
- Limited support in PDF and PS contexts

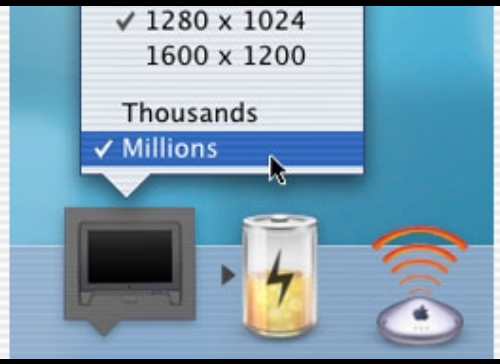
Data Managers

- Data Providers
  - Images, PDF Document
- Data Consumers
  - PDF Context
- Convenience Managers
  - From Memory
  - From URL

Miscellaneous

- Double buffered on-screen drawing
- **CGContextFlush**
- **CGContextSynchronize**
- QD and CG drawing
  - See Graphics & Imaging Tips & Tricks talk

Demo



Documentation

- Quartz Primer
- Inside Mac OS X: Drawing with Quartz
- APIs in CoreGraphics.framework/Headers under ApplicationServices.framework

Roadmap

108 PDF, Quartz, and Mac OS X: Learn about Mac OS X's support for PDF	Room J2 **Tues., 9:00am**
110 Drawing Unicode Text with ATSUI: Learn how to draw Unicode text on Mac OS X	Room J2 **Tues., 3:30pm**
117 Image Capture Framework: System-level support for Digital Cameras	Room C **Wed., 10:30am**

Roadmap

118 ColorSync: The color engine of Mac OS X	Room C **Wed., 2:00pm**
113 Text on Mac OS X: All about DrawThemeText, Unicode Edit Text Control and MLTE	Hall 2 **Wed., 3:30pm**
404 OpenGL: High Performance 2D: Blazingly fast 2D graphics using OpenGL	Room J2 **Wed., 3:30pm**
124 Printing: Using Mac OS X's print architecture	Room A2 **Thurs., 3:30pm**

Roadmap

132 Graphics & Imaging Tips & Tricks: Optimize your graphics and printing	Room A2 **Fri., 9:00am**
FF118 Feedback Forum: Graphics: Give us your feedback on Mac OS X graphics	Room J1 **Fri., 2:00pm**

Who to Contact

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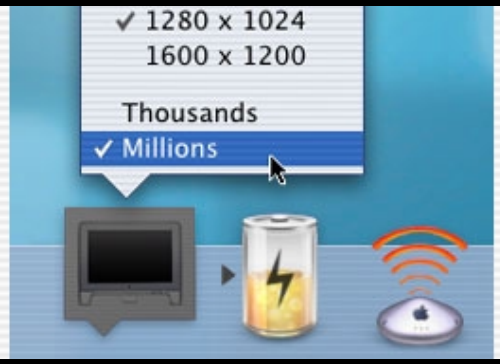
Q&A



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WWDC

Worldwide Developers Conference 2001